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Identification of the Critical Components of Oiled Seabird Rescue and Rehabilitation

A Summary Report of the Current Research and Established Protocols of Oiled Wildlife Rehabilitation

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Prepared and submitted by the Oiled Wildlife Care Network
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Washington State: Identification of the Critical Components of Oiled Seabird Rescue and Rehabilitation

Written by Sue Campbell and Michael Ziccardi

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I. INTRODUCTION

A. Background and Overview

The purpose of this project is to provide a review of the science behind the best response and rehabilitation practices for oiled wildlife and present this information to the Washington Department of Fish and Wildlife (WDFW). WDFW contracted with the University of California at Davis' (UCD), School of Veterinary Medicine, Wildlife Health Center to identify and, where possible, quantify the critical components of oiled seabird rehabilitation to increase the success of oiled wildlife rescue and rehabilitation efforts.

The University of California, Davis, School of Veterinary Medicine, is the largest veterinary school in the nation, and conducts an integrated, statewide mission of teaching, research and service benefiting animal, human and environmental health. The school is the primary health resource for California's companion animals, livestock and wildlife. Research continues to be one of the most critical components of the School of Veterinary Medicine's programs and is the primary way scientifically based information and technology improves the health and well being of animals, the environment, and public health.

The Wildlife Health Center is a multidisciplinary program within the School of Veterinary Medicine at UC Davis that focuses on the health of free-ranging and captive terrestrial and aquatic wild animals. It is the umbrella organization under which faculty, staff, students, and other partners come together to address the complex issues surrounding wildlife and environmental conservation in a changing world. The Center draws upon faculty expertise spanning a wide range of wildlife species and scientific disciplines and attracts students from around the world to participate in its research and educational programs. The Programs include the Marine Ecosystem Health Program, Southern California Ecosystem Health Program, Resource Assessment Program, Wildlife Veterinary Services, and the Oiled Wildlife Care Network (OWCN) and draws directly on the expertise of eight wildlife veterinarians and two tenured faculty to direct and implement the program's goals.

The Oiled Wildlife Care Network was chosen to identify the critical components of oiled wildlife rehabilitation for the state of Washington because of their expertise, experience, and scientific background in oiled wildlife response, and for being widely recognized as the most advanced and innovative public-private partnership designed for oiled wildlife response in the world. This program was initially outlined in a series of legislative acts (beginning in 1990) charging the Department of Fish and Game, Office of Spill Prevention and Response (OSPR) to establish rescue and rehabilitation stations for seabirds, sea otters and other marine mammals throughout the state. Since its inception in 1994, the OWCN has developed a statewide collective of wildlife care providers and regional facilities interested in working with oil-affected wildlife. The collective mission of the OWCN is to strive to ensure that wildlife exposed to petroleum products in the environment receive the best achievable treatment by providing access to permanent wildlife rehabilitation facilities and trained personnel that are maintained in a constant state of preparedness for oil spill response within California.

Through focused research and development of animal care protocols, the OWCN has streamlined the response to oil spills and greatly increased the chances of survival for oiled wildlife. During response, the OWCN receives assistance from its twenty five (25) participating organizations and uses one or more of twelve (12) regional facilities either built specifically for, or modified to accommodate, oiled wildlife. All OWCN facilities have been developed in cooperation with universities, schools, zoological parks or wildlife rehabilitation organizations. When not in use for emergency oil spill response, these facilities operate additional year-round programs that benefit and educate the community. The facilities are maintained in a constant state of preparedness, are stocked with emergency equipment and supplies, and are staffed by skilled experts and local volunteers specifically trained in the care of oiled birds and marine mammals. The OWCN provides annual training opportunities for participants to ensure personnel are practicing state-of-the-art skills. Participants of the OWCN are globally recognized as experts in their field and are often requested to respond to environmental accidents affecting wildlife and to consult on response preparedness worldwide.

In addition to establishing oiled wildlife care stations, the OWCN has recognized the need for both applied and basic research into the effects of oil on wildlife and technology development for optimizing treatment of oiled wildlife. Therefore, in 1995, research and technology development was added to the tasks to be accomplished by the OWCN. Since 1996, more than seventy (70) applied research projects funded by the competitive grants program totaling more than $1.5 million in support, have increased the knowledge of the consequences of oil exposure to wildlife and improved the quality of response technology for oil spills in California and around the world.

The Wildlife Health Center provides the management structure for daily operations of the OWCN, and current employs six (6) full-time administrative and professional staff members including two full-time veterinarians and several additional staff in cost- and labor-sharing capacities. The collaboration between UCD and OSPR also allows strong support and expertise in veterinary services, research related to oiled wildlife care, scientific experts to review competitive grant proposals, and access to the latest technology and equipment.

Since its implementation, the OWCN has responded to over forty (40) spills and has collected over 4,500 live birds for care in OWCN facilities. In addition to these spills, participants continue to collect, rehabilitate and release oiled birds that have not been declared part of a spill event. Successful release rates have ranged from 0 – 100% during different events; however, on average 50 – 75% of all live oiled wildlife collected by the OWCN are successfully rehabilitated and released. Rehabilitation success is affected by many factors including oil type, species affected, location and season of release and length of exposure. It should be noted that these release rates are significantly higher than those reported for similar species outside of California, and at this point, represents best achievable care of oil-affected wildlife.

Therefore, through drawing on this experience and training in oiled wildlife care, the OWCN has developed this report for WDFW as an analysis of established oiled wildlife protocols, both internationally and nationally, scientific research focusing on the advancement in the care of oiled animals, as well as the risks of oil spills in sensitive areas along the coast of Washington. The report also includes research on the effects of oil on seabirds and the pros and cons of oiled

wildlife rehabilitation to provide background information and to establish the reasoning behind rescue efforts.

The scope of this work is categorized into these parts: 1) the identification and characterization of the assumptions that the project is based on; these assumptions were generated by the WDFW and the OWCN agreed with these assumptions for the bases of the document; 2) the identification of the critical components of a Qualified Responder and the establishment of the standards that the individual or organization must meet to manage the entire response process; 3) the identification of the critical components of oiled wildlife care which are elements of an oiled wildlife rescue operation that must be present in order for the operation to succeed; and 4) the identification of the critical components of a rescue facility, and how the each component is utilized throughout the rehabilitation process.

B. Methods

This summary report followed "best available science" principles by using the most credible resources available, documenting how those sources were used with an extensive bibliography, and can defend all points made based on the sources used. The different sources of information that were used to compile this report (and in decreasing priority of use) were: 1) peer-reviewed scientific literature, 2) non-peer reviewed scientific literature, 3) gray literature and presentation abstracts, and 4) personal communications with a variety of experts, including expert opinions of the report's authors based on spill and management experience. In many instances throughout this document, the reliance of "gray literature" and personal communication sources was necessary because, unlike "hard" science fields, many rehabilitation efforts are not reported in the formal scientific method.

The scientific literature was obtained through the use of library literature searches using the keywords: emergency response, oil spill, petroleum, petroleum toxicity, avian, seabird, wildlife, and wildlife rehabilitation. *Oiled Wildlife Response in California – A Summary of Current Knowledge of Populations at Risk and Response Techniques*, prepared by the Oiled Wildlife Care Network was also utilized as a literature search tool for this project. This document is a summary of what is known to date from scientific papers and reports generated by universities, government agencies, industry, or the private sector, which elaborate upon established methods, techniques, or knowledge in many different aspects of oiled wildlife research and response capabilities. The Wildlife Health Center keeps a library of research papers that were gathered while researching the summary document; the library was utilized for this report as well. Another tool to collect research papers for this project was searching the bibliographies of the peer-reviewed papers that were read. These bibliographies were an immense source of information.

There is also a large amount of gray literature used to compile information for this document. The use of conference proceedings, established OWCN oiled bird protocols, the United States Fish and Wildlife Service's *Best Practices for Migratory Bird Care During Oil Spill Response*, and the International Alliance of Oiled Wildlife Responders' *Standards and Guidelines for Care of Oiled Wildlife*, are all professional documents that were sources of information.

Personal communications with qualified individuals were also incorporated into this project. Glenn Ford is a leading expert in designing mathematic models for estimating total direct bird mortality from oil spills; Deirdre Goodfriend has responded to numerous national and international oil spills, has experience designing oiled wildlife care facilities, and is the former Rehabilitation Director of the International Bird Rescue and Research Center; and Steve Hampton is a Resource Economist with the Office of Spill Prevention and Response California Department of Fish and Game.

C. Glossary of Terms

Acute Spill: An oil spill having a rapid onset and following a short, but oftentimes severe, course.

Chronic Oil Spill: A spill that lasts for a long period of time, or marked by frequent recurrence.

Dynamic Facility Areas: Those dedicated areas in where size change with the number of birds in house.

Oiled Wildlife Rehabilitation Facilities:

(Permanent): Established structures that are either entirely dedicated to supporting oiled wildlife during a spill event or have the innate capacity to quickly be converted over to the use of treating oiled birds.

(Temporary): Facilities that are not specifically dedicated to or modified to allow, oiled wildlife rehabilitation. They may include existing buildings or structures that are modified at the onset of a spill for the purpose of oiled wildlife rehabilitation or temporary facilities that are set up and/or built to meet the need of an oiled wildlife response.

Incident Command System (ICS): The management structure established for overseeing personnel, facilities, equipment, and communications during the response, containment, and clean up of an oil spill event.

Intake: The process where oiled birds are admitted into the rehabilitation facility and evaluated for ongoing care.

Primary Care: The methodology for ensuring that oiled birds are 'stable' prior to transportation to an established rehabilitation facility, often done in the field or temporary facility close to the spill area.

Qualified Responder (QR): An organization that has significant oil spill response experience and the trained staff necessary to successfully manage and supervise all aspects of an oiled bird rescue and rehabilitation effort, which include integration into the ICS system, search and collection, primary care, transport, and rehabilitation.

Rehabilitation: The process of caring for oiled wildlife using established husbandry and medical protocols, which includes intake, cleaning, and subsequent release of healthy animals to their natural habitats.

Release: The return of rehabilitated oiled wildlife back into their natural environment so that they are able to resume their place in the ecosystem. These animals must be biologically and behaviorally normal and capable to compete with conspecifics in the same manner prior to suffering the effects of being oiled.

Search and Collection: The process during which oiled animals are identified in the field, captured, handled and transported to the point of initial treatment (i.e. primary care or rehabilitation facility).

Semi-static Facility Areas: Those dedicated areas within a rehabilitation facility where space requirements increase not directly with animal numbers but in a stepwise manner with severity of the spill.

Static Facility Area: Those dedicated areas within a facility where space requirements do not change with the number of birds.

Transport: The method and procedures by which animals are moved from one site to another (i.e. field to primary care) by vehicle.

Triage: The process by which impacted birds are categorized as to treatment priority and degree of rehabilitation effort.

Volunteer: Any person who provides goods or services without receiving a salary or recompensation for time. Volunteers may receive funds for meals, transportation, lodging, or other expenses dependent on the response.

II. ASSUMPTIONS AND BACKGROUND INFORMATION RELATED TO THE EFFECTS OF OIL ON WILDLIFE

A. Assumptions

The project was based on several assumptions provided by the WDFW. The assumptions were that the recommendations be based on : 1) an acute spill from a point source that released a heavy product, i.e.: bunker or crude oil; 2) a total of 100,000 birds are impacted; 3) the average size bird that was rescued weighs 1 kg and is socially colonial in nature; 4) the average bird's ability to handle rehabilitation stress equals that of a common murre; 5) a maximal search and collection effort was made; and 6) the rescue and rehabilitation effort was specific to birds and would not include other marine organisms. It is important to note that while many of the components identified in this document hold across product and species lines, each spill scenario should be evaluated individually to ensure appropriate and adequate preparation and planning.

For example, jet fuel will cause skin burns and a quick wash during primary care may be appropriate. Another example is a spill affecting larger birds such as pelicans; the facility space and utility demands will be greater and the indoor and outdoor holding pens will be all together different. These assumptions were to lay the ground rules in order to establish the critical components, but each spill will have its own unique circumstances.

The first assumption is supported by several spills that have occurred in Washington. On December 22, 1988, the barge *Nestucca* was punctured and 231,000 gallons of Number 6 fuel oil escaped into the waters of Grey's Harbor and the Pacific Ocean (Ford et al., 1991). The currents took the oil north, affecting outer Washington coast beaches, including several beaches in Olympic National Park, and headed as far north as Vancouver Island, British Columbia.

A total of 10,336 birds were collected on Washington beaches; 7,244 were dead when collected, 2,065 died or were euthanized at rehabilitation centers, and 1, 027 were cleaned and released (Ford et al., 1991). Common murres (*Uria aalge*) made up 72 percent of the total affected birds.

On Vancouver Island, a total of 3,137 oiled seabirds were collected; 3,104 dead, 33 live birds, and 19 were cleaned and released. Common murres made up 42 percent of the total affected birds, followed by Cassin's Auklets (*Ptychoramphus aleuticus*) at 32 percent of the total. Based on numerical models, over 10,000 seabird carcasses were estimated to have been deposited on Vancouver Island (Burger, 1991).

Based on the *Seabird Mortality Resulting from the Nestucca Oil Spill Incident, Winter 1988-1989*, there was an estimated 55,912 total direct bird mortalities, of which 30,000 were common murres (Ford et al., 1991). Using numerical models, it was estimated about one million seabirds occupied the waters of their study area during January 1990. The study area was from Estevan Point, Vancouver Island, to the Columbia River mouth, and from the shoreline out to the 100-meter isobath. This area includes the area impacted by the spill, Gray's Harbor and north to Vancouver Is. Bird species particularly vulnerable to oil (loons, grebes, cormorants, scoters, and alcids) comprised 40 percent of the estimated population. Alcids made up the majority of the birds, with an estimated 296,717 being common murres. The highest densities of birds were found west of the entrance of the Straits of Juan de Fuca; the densities averaged between 40-1800 birds per km^2.

Another example of a point source spill involving heavy petroleum products released in this area was the *Tenyo Maru* spill. On July 22, 1991, the Japanese fishing vessel *Tenyo Maru*, and the Chinese freighter *Tuo Hai* collided within Canadian Territorial waters approximately 20 mile northwest of Cape Flattery. The *Tenyo Maru* sank at the collision site carrying an estimated 345,800 gallons of intermediate fuel oil, 97,800 gallons of diesel fuel, and 22,500 gallons of fish oil (The *Tenyo Maru* Oil Spill Natural Resources Trustees, 2000). A large amount of oil leaked out soon after the vessel sank, and undetermined amounts continued to leak for more than a month after the collision. The oil spread from Vancouver Island, British Columbia to northern Oregon, with the heaviest oiling occurring along the Makah Indian Reservation and the Olympic National Park shoreline. The Natural Resources Trustees estimated that between 3,740-19,559 common murres and between161-273 federally threatened marbled murrelets (*Brachyramphus*

marmoratus) were killed; the equivalent of 7-11 percent of the total outer coast population (The *Tenyo Maru* Oil Spill Natural Resources Trustees, 2000).

A total of 4,300 bird carcasses, 73 percent of which were common murres, were recovered during search and collection efforts. The seabird mortality for this spill has been estimated at 60,000 (Steve Hampton, OSPR; pers. comm). There were 740 birds rescued alive, and only 13 percent (97) were released. There was no post release tracking, so their ultimate fate is unknown.

There have been spills within Puget Sound as well. In 1985, the *Arco Anchorage* spilled 239,000 gallons of North Slope crude oil while at anchor in Port Angeles. A total of 1,917 seabirds were found oiled, of which 355 were dead when collected (State of Washington, 1987). The International Bird Rescue and Research Center treated 1,562 oiled seabirds; 1,243 died and 281 were released (IBRRC, 2003). The Marine Resources Damage Report estimated the total seabird mortality from this spill to be approximately 4,000 (State of Washington, 1987). Another example is a smaller spill that happened on February 22, 1991. Approximately 40,000 gallons of Alaska North Slope crude oil were released into Fidalgo Bay from the Texaco Refining Facility at Anacortes, Washington (Washington Department of Wildlife, 1991). A total of 166 oiled birds were collected; 80 dead and 86 live animals. Of the live birds rehabilitated, 21 were released (Washington Department of Wildlife, 1991). The majority of the live and dead birds were collected during the first few days following the spill. A numerical model was not established for this spill; therefore the total mortality has not been estimated.

The common murre was chosen as the model bird for this report based on the second and third assumptions the WDFW gave the OWCN; the average size bird rescued weighs 1 kg, and the average bird's ability to handle rehabilitation stress equals that of a common murre. The adult common murre weighs approximately 1 kg; the mean weight for females equals 979g; and the mean weight for males equals 1006g (OWCN, 2000). Given the propensity of common murres to be affected by oil spill events in Washington (Ford et al., 1991; The Tenyo Maru Oil Spill Natural Trustees, 2000), there is evidence that supports this assumption. In addition, more common murres have been killed by oil than any other species in California, and in Alaska's *Exxon Valdez* oil spill, this bird made up the largest number of deaths from the spill (Jessup and Leighton, 1996).

The last two assumptions, the maximum search and collection effort is made and the rescue and rehabilitation effort is specific to birds, were given as background information not needing supportive documentation.

Based on these assumptions in combination with models that have been used in the Washington state area, it was determined that approximately 6,000 birds would be affected, for in a spill impacting 100,000 birds, a dead bird multiplier would be used to determine the proportion of animals collected versus those impacted. Usually, for purposes of estimation, a multiplier of 10 is used, however, in discussions with those determining these models (S. Hampton, G. Ford), it is felt an approximate multiplier of 8 would better represent a nearshore spill with active and experienced search and collection activities. Therefore, we would estimate that 100,000/8, or 12,500 live and dead birds, would be collected. Based on several previous large-scale bird

events on the West Coast, we have seen that approximately 50% of those animals collected are live and able to be delivered to a rehabilitation facility. Thus, 12,500 * 50% = 6,250 live birds collected or, to ease subsequent calculations, 6,000 animals to determine rehabilitation personnel and facilities needs.

B. Estimating the Mortality of Seabirds Following Oil Spills

It is generally accepted that there is no clear relationship between the volume of oil spilled at sea and the resultant number of oiled seabirds (Burger 1993). Sometimes many birds die from relatively small spills, and conversely, only a few birds may die from a large spill. For a variety of reasons, the number of birds collected (live and dead) on the beach may be only a small fraction of the total number impacted, and in most cases the majority of the birds are never found. Some of the factors that affect the total number of birds found alive or dead include being scavenged by other animals (sometimes in less than 24 hours), getting re-washed into the water with an incoming tide, removal or burial by the public, carcass loss at sea, and inefficiency of the search effort (OSPR, 2002).

For this report, the OWCN was asked to estimate the percent of the total number of impacted birds that would reach the beach and how the estimated impacted birds would vary from the Pacific coast beaches vs. the Puget Sound beaches. Based on previous spills and spill models, the OWCN could not identify evidence or documentation to support a significant difference between recovery of dead and live birds from coastal and inland waters (Glen Ford, pers comm). However, there are differences in the natural behavior of offshore and nearshore seabird species that would affect the timing of coming out of the water and the condition of the oiled animals once that occurs. The natural behavior of offshore species influences recovery rates in that these species tend to have no terrestrial habitat, will actually avoid beaches even when oiled, and be in a weaker state when they eventually beach (Glenn Ford, pers. comm). Bay or estuary species have a terrestrial habitat and haul out on beaches. When oiled, species that tend to haul out may have better energy reserves when collected.

Scavenging and the species affected will also influence recovery rates. For example, in estuaries, typically there is a different mix of scavengers (generally fewer than coastal beaches) so more carcasses are found. Small bird carcasses will tend to be scavenged at a higher rate than larger birds because the scavengers can carry the whole body, whereas for larger birds, the scavenger may eat only pieces and leave enough for search and collection personnel to collect (Glenn Ford, pers. comm).

A variable that does affect recovery rates is whether or not there is an onshore wind because onshore winds will push the animals ashore. The rule of thumb is if the trajectory component is keeping the birds offshore, carcasses will begin sinking after 10-14 days, and faster in rougher water (Glenn Ford, pers. comm). In the calm waters of Prince William Sound, some carcasses oiled from the *Exxon Valdez* floated for 20 days (Ford et al., 1996). No differences in sinking rates between species have been found, but the greater the distance that a carcass must drift the greater the chance that it will sink (Ford, et al., 1996).

Lastly, while there has been extensive work done to create models to estimate total mortality, the models are spill specific. There is not a set "dead bird multiplier" (e.g., 1 bird found = 10 birds dead) because each spill is different. Variables such as weather, currents, type of oil spilled, and the time of year are unique for each particular spill (Steve Hampton, OSPR, pers. comm).

The *Nestucca* and the *Tenyo Maru* are examples of spills that affected seabirds along the Pacific coast. The *Nestucca* report estimated that 56.5 percent of the impacted birds were lost at sea, therefore 43.5 percent landed on the beach (Ford et al., 1991). A total of 12,446 birds were found dead, but the estimated mortality was 55,912 birds; the "dead bird multiplier" for the *Nestucca* spill was 4.5. A total of 4,300 dead birds were found following the *Tenyo Maru* spill, but the estimated mortality was 60,000; therefore the "dead bird multiplier" was 14.0 for that spill.

C. Seabird Populations and Oil Spill Risks

Risk equations multiply probability by consequences, and as United States Coast Guard Vice Admiral Ray Riutta, Commander, Pacific Area, stated in his keynote address to the 2000 Annual Meeting of the Pacific States/British Columbia Oil Spill Task Force, "the probability of a major oil spill is small at any time, but the consequences are enormous if one occurs."

More than 72 percent of Washington's marine birds nest on the outer coast of Washington (Speich and Wahl, 1989). Approximately 22 percent of Washington's marine birds nest within the inner marine water, with 16 percent found in the Straight of Juan de Fuca on Protection Island (Speich and Wahl, 1989).

These areas are at risk of spills because the high rate of vessel traffic in these vicinities. Based on surveys of coastal transits for July 1998 through June 1999, the West Coast Vessel Traffic Risk Management Project Workgroup found that traffic density is higher along the section of the West Coast between the Strait of Juan de Fuca and Los Angeles/Long Beach, than north of the Strait. The vessels that the Workgroup focused on included tank, cargo/passenger, and fishing vessels of 300 gross tons or larger. Figure 1 illustrates the overall sensitivity of this region, and the areas of coastal Washington that have the highest level of sensitivity based on distribution of seabirds, marine mammals, listed species, and fisheries (West Coast Offshore Vessel Traffic Management Workgroup, 2002). In addition, there is a higher risk associated with converging vessel traffic at port entrances and the Strait of Juan de Fuca has the highest number of vessels arriving into port in an average year along West Coast (West Coast Offshore Vessel Traffic Management Workgroup, 2002).

Fig 1: Overall sensitivity of Pacific Coastal waters based on distribution of seabirds, marine mammals, listed species. Source: *West Coast Offshore Vessel Traffic Risk Management Project, 2002*.

D. The Effects of Oil on Marine Wildlife

There are many variables that produce different effects of petroleum products on wildlife. Some examples include the type of oil that was spilled, the wildlife species affected, route of exposure, health conditions of individual animals at the time of the spill, where and when the spill occurred, and the weather. Different types of oil have different levels of toxicity. This report is focusing on heavy petroleum products such as bunker or crude oils, the primary effects of which are caused by the physical coating of the animal and, later, the gastrointestinal tract from ingestion of the oil by the animal trying to clean itself (Tseng, 1999).

Because oils have a complex composition and seldom have been analyzed fully in conjunction with toxicological studies, the compounds in oils that are responsible for their effects on wildlife are not well defined. One exception is the family of compounds known as polycyclic aromatic

hydrocarbons (PAHs). The heavy distillates such as bunker C oil commonly contain high PAH concentrations (Leighton, 1995). PAHs are known to kill cells in the tissues of the intestines, organs of the immune system, bone marrow, and liver, as well as cause damage to red blood cells, and cause short and long-term reproductive abnormalities (Leighton, 1995).

The effects of oil also vary from species to species. The most vulnerable marine species are those without a blubber layer, mainly aquatic birds and fur bearing marine mammals, such as sea otters. These animals rely on their feathers or fur to insulate them from the frigid waters in which they live. Once they are exposed to oil, the insulating properties are lost, and the animals are subjected to the effects of hypothermia, which leads to stress, starvation, and can result in death.

There is sufficient data to establish that birds do die as a result of oil pollution, that mortality can be very large and perhaps devastating to particular populations, and that certain groups such as sea ducks and alcids usually make up a large percentage of the death toll (Leighton, et al., 1985). Seabirds share a number of characteristics that make them particularly vulnerable to petroleum products. These characteristics include coming together in large aggregations for several months each year to breed or migrate; spending long periods of time sitting on or feeding from the ocean's surface; feeding on other species that may be sensitive to the toxic effects of oil; and having a relatively low reproductive potential (Leighton et al., 1985).

Petroleum oils are toxic to birds in four primary ways. First, external contamination of birds with oil results in physical alterations of the structure and function of feathers causing matting and loss of insulating and water-repellent properties. Death due to various combinations of heat loss, starvation, and drowning frequently follows. Additional external affects include dermal burns and corneal ulcerations. Second, ingestion of oil from preening or eating contaminated food causes a variety of physiological alterations, some of which lead to mortality. Third, during the early stages of an oil spill, the oil releases volatile compounds which can cause respiratory distress, physiological damage and central nervous system alterations in affected animals. Fourth, reproductive effects such as contamination of eggs causing very high mortality of embryos, behavioral changes leading to decreased mating, and a demonstrated decreased survivability of chicks all can be caused by exposure (Leighton, 1995).

E. The Pros and Cons of Oiled Wildlife Rehabilitation

The history of anthropogenic oil spills corresponds with the beginning of the industrial revolution and the need for petroleum products to power it. With society's increased dependence on oil came the transport of larger and larger amounts of oil by sea. The first reports of wildlife, especially birds, dying as a result of petroleum products in the marine environment, date back to the early 20th century (Ibis, 1926). Simultaneously, the first attempts to rehabilitate wildlife affected by these spills, as well as the controversy over the merits of the rehabilitation of these animals, began.

Oiled wildlife rehabilitation is a very contentious topic. This debate puts scientists on opposite sides time and time again. Some scientists support oiled wildlife rehabilitation because they see it as a research opportunity. The individual animal is like a window into the population as a whole. The knowledge gained from individual animals may shed a bit of light on the survival of the species. Furthermore, the medical techniques and protocols that have been established

through working on non-threatened species involved in oil spills will aid in the treatment of threatened or endangered species that are being rehabilitated for both oiled and non-oil related reasons (Tseng, 1999). There are also humane and ethical reasons to rehabilitate wildlife oiled by man-made mistakes.

Others argue that releasing rehabilitated animals back into the wild can be harmful to the entire population with the spread of disease, may actually have negative effects on the gene pool, and is an inappropriate use of limited resources (Williams and Williams, 1996). Another argument is that rehabilitation is only focused on the welfare of the individual animals, not the conservation of the species, its population, and the ecosystem in which it lives (Estes, 1998). In addition, some scientists question the cost effectiveness of oiled wildlife rehabilitation, based on studies that have shown low post-release survival rates (Estes, 1998 and Sharp, 1996). For example, roughly $17 million was spent on the sea otter rehabilitation program, including construction costs, during the *Exxon Valdez* Oil Spill, which was equivalent of spending $80,000 per individual released back into the wild (Estes, 1998).

Both sides of the issue make very strong points, however the bottom line is that oiled wildlife response is federally mandated. The Oil Pollution Act of 1990 (OPA 90) requires that all companies involved in the manufacture and transport of petroleum products develop contingency plans for oil spill cleanup and wildlife response, and, when a spill occurs, the responsible party is held liable for the costs of both (EPA, 1990). In most cases less than five percent of the total cost of oil spills goes to oiled wildlife rehabilitation. For example, the total costs associated with the *Exxon Valdez* oil spill were estimated at nearly $12 billion (Helton and Penn, 1999) therefore only 0.70% of the total went to the rehabilitation of oiled sea otters.

The rehabilitation of oiled wildlife is legally mandated, but the level of care is not. The WDFW is establishing their rules of oiled wildlife rehabilitation in order to improve the overall level of response for the State. Research has shown that immediate access to medical treatment and removal of the contaminant oil has been proven to be a critical component for increased survival rates of affected animals (Mazet et al., 2002).

III. OVERVIEW OF THE CRITICAL COMPONENTS OF OILED WILDLIFE RESCUE AND REHABILITATION

Note: all information contained in this chapter was compiled from a variety of established protocols and standards in oiled wildlife care: the International Alliance of Oiled Wildlife Responders, *Standards and Guidelines for Care of Oiled Wildlife*; the United States Fish and Wildlife Service, *Best Practices for Migratory Bird Care During Oil Spill Response*; and the Oiled Wildlife Care Network, *Protocols for the Care of Oil-affected Birds*.

A. General Oiled Wildlife Rescue and Rehabilitation Requirements

1. Background

When an oil spill occurs, the main priorities are to stop the release of oil from the source, contain the oil spilled, and protect all natural resources from damage. If wildlife is in the area, every effort should be made to stop oil from contacting the animals, for if contact is made, the Responsible Party will be charged with the duties of ensuring that all affected animals are cleaned, rehabilitated, and returned to the wild.

Oiled wildlife response begins with the development and implementation of a wildlife recovery and care plan under the direction of the Wildlife Branch Director (WBD) who directs these elements within the Incident Command System (ICS). The WBD in Washington will be responsible for notifying the Qualified Responder (QR) in a timely manner to ensure that oiled wildlife gets immediate care. The QR would fall right below the Wildlife Branch Director on the Unified Command flow chart (Fig. 2).

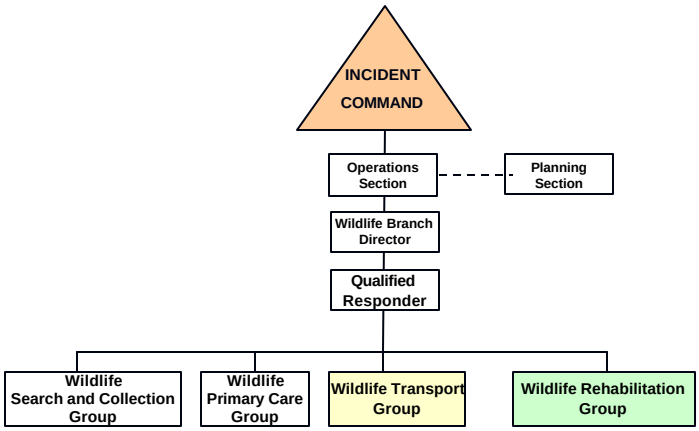

Figure 2. Possible Unified Command chart for spill response in Washington State.

The dynamic nature of spills creates unique scenarios that are difficult to address during planning. Variables such as the amount of oil spilled, type or product, and the number of animals affected will vary from spill to spill, and therefore it is recommended that the WBD and the ICS have the authority to choose an appropriate QR(s) for a particular spill event. The organization's size, level of oil spill experience and training may change with the severity of the spill. The following is based on the assumption that 100,000 animals have been impacted, and a large scale effort will have to be conducted in order to deal with such a catastrophic event.

The Qualified Responder (QR) would be an organization that has significant oil spill response experience and the trained staff necessary to successfully manage and supervise all aspects of an oiled bird rescue and rehabilitation effort, which include search and collection, remote site stabilization/primary care, transport, and rehabilitation, as well as understand how their operation works within and under the Wildlife Branch of the ICS.

The QR would need to be available on a 24-hour basis 365-day a year, and, in the event of an oil spill, the QR would begin the response within 24 hours.

2. Critical Components

a) Personnel: The organization must have a staff that has a dynamic knowledge base of oiled wildlife response, which includes experienced, professional wildlife biologists to manage the assessment and search and collection operations, and oiled wildlife rehabilitation specialists to manage the primary care, transport, and rehabilitation efforts. The QR would need to provide or make arrangements for an experienced wildlife veterinarian who must approve all medications, medical treatments, diagnostic and prognostic procedures on oiled wildlife.

> All staff should be knowledgeable and trained in human health and safety issues pertaining to petroleum exposure and animal handling (HAZWOPER, HAZCOM, or other training per Washington State regulations) and have working knowledge of the Incident Command System (ICS). All members of the QR would work under the developed ICS structure, with at least one member actively assisting and working with the Wildlife Branch Director. There should be sufficient staffing numbers to manage all aspects of the wildlife response effort as well as oversee/supervise each department within the rehabilitation center at each phase of the response: intake, pre-cleaning holding, cleaning, post-cleaning holding, and release.

b) Experience: Experience should be heavily weighted when choosing a QR for a specific spill. If a spill were to occur, the QR would provide a resume´ of the oil spill and rehabilitation experience of key personnel within the organization, including the success of spill responses, in order to prove that they are capable of performing all required aspects of the oiled wildlife response. The QR must having working knowledge of the established oiled wildlife protocols and conduct all aspects of the oiled wildlife operation based on these protocols. Having been involved with the establishment and continued research on these protocols is beneficial.

c) Training: The minimum level of training for supervisory personnel and above is at least 40 hours of professional instruction in wildlife care and at least 24 hours of practical experience in oiled wildlife response. These personnel will also have to meet the applicable Federal and State Occupational Health and Safety Agency requirements for working with hazardous materials. Personnel should also have ICS training and understand and follow the proper chain of custody from capture to release.

d) Equipment and Supplies: There is an extensive list of equipment needed for all phases of oiled wildlife response. Each of the following section will list the critical equipment required in order to provide the best achievable care to oiled animals.

Note: One of the QR's first responsibilities would be to assess the environment in which the spill occurred in order to determine to what extent the wildlife in the area are becoming affected by the oil, identify the species most at risk, and identify any areas of ecological or cultural concern that cannot be disturbed during the response effort. This assessment is vital in developing and implementing an effective search and collection effort. The information gathered in the field at this time is also used to begin identifying possible facilities that can be altered to fit the needs of oiled wildlife rehabilitation, if there are no permanent facilities in place, and to begin the process of identifying and locating the needed equipment and supplies.

B. Search and Collection Requirements

1. Background

Search and Collection (S&C) is the process during which oiled animals are identified in the field, captured, handled and transported to the point of initial treatment i.e. primary care or rehabilitation facility (International Alliance of Oiled Wildlife Responders, 2003). This phase of the operation begins immediately following activation until all visibly affected birds are captured, which usually lasts anywhere from weeks to months depending on the severity and longevity of the spill. The first priority of those organizing and managing the search and collection activities must be human safety. Key elements of a successful search and collection operation include, but are not limited to, working in teams of at least two; establishment of capture, safety, and communication plans; use of personnel who have been trained in proper capture techniques to ensure that birds are captured as quickly as possible with minimal pursuit; the appropriate availability and use of capture equipment such as dip nets, net guns, and mist nests; use of appropriate live bird handling techniques; and use of appropriate containers for each species of bird involved.

The goal of the S&C effort is the immediate and safe capture of the highest percentage of impacted animals so that they may be treated at a point when the effects of the contamination are in the earliest stages (International Alliance of Oiled Wildlife Responders, 2003). S&C is instituted rapidly following activation because early capture and care of oiled birds can increase survival. Should threatened or endangered species be affected, directed efforts towards the preferential capture of these animals are warranted.

Birds that have already beached should be captured first, as these animals are usually the most affected and/or debilitated. The use of boats to capture oiled birds in the water should be strongly considered (when available and applicable) because this often allows collection of animals before significant debilitation occurs and may ultimately improve the rehabilitation success. Collection of carcasses should be done simultaneously to remove the contaminant from the environment, to reduce secondary effects to scavengers, and to reduce the chance of "double counting" affected dead animals during damage assessment. Other responsibilities of S&C personnel include determining the resources needed, communicating these needs the Wildlife Branch Director (who then alerts the Logistics Section), properly document all S&C activities, and maintain proper chain of custody.

2. Critical Components

a) Personnel Requirements: A sufficient number of teams (of at least two) to provide adequate coverage throughout the spill area. This may require multiple teams within a single section or one team covering several divisions. A Coordinator should be identified to direct and organize S&C efforts at a central location.

b) Experience and Training: The QR will provide trained, experienced staff with appropriate OSHA training (HAZWOPER or equivalent) to oversee, conduct, and lead search and collection of live and dead oiled birds. All staff involved with search and collection efforts should also be trained and have experience in marine safety and specialized training, such as boat and ATV safety, proper animal handling skills, and recognize the normal behavior of oiled wildlife.

c) Equipment:

(1) Human safety equipment: Proper and appropriate Personal Protective Equipment (PPE), such as tyvek suits, nitrile gloves, boots (steel toed if required), safety glasses and first aid kits, or other equipment deemed necessary by the site Safety Officer. When capturing on or near the water, proper Personal Floatation Devices (PFD) must be worn, such as life preservers or survival suits. Cell phones and/or VHF radios are critical communication tools needed to ensure human safety and timely communication in the field. Identification must be worn (i.e. jackets and uniforms) and proof of OSHA training should be carried.

(2) Capture equipment: Hand nets, mist nets, traps, or other methods of capture dependent on species, well-ventilated pet carriers, pillowcases, and towels.

(3) Support equipment: Maps, Global Positioning System (GPS) units, trucks, boats, ATV's, binoculars and/or spotting scopes, and appropriate forms for recording data.

d) Specific Responsibilities:

(1) Assessment: It is critical for S&C teams to gather information on the number of species in the immediate spill area, obvious oiled animals and their locations, and local foraging, roosting, and breeding areas. It should also include environmentally and culturally sensitive areas that may be adversely affected by the capture program. In Washington, the Reconnaissance and Resources at Risk staff may play a major role in this phase.

(2) Capture Plan: Developing a capture plan with human safety as the priority is crucial for an effective collecting program. The safety of both oiled and non-oiled animals should be considered such that the number of live oiled birds captured is maximized while minimizing disturbance to non-oiled animals. The capture plan should identify the special situations that the capture of oiled wildlife may not be

attempted, including environments that pose too great a safety risk to personnel or sensitive areas such as rookeries or colonies of threatened or endangered species.

(3) Communication Plan: A plan for communication between and within the S&C unit must be defined. At a minimum, all S&C staff should contact the Coordinator when on and off the search area, and report field activities and capture success. The S&C Coordinator should report to the QR supervisor or the WBD at defined pre-selected times to report the summary of activities.

(4) Documentation: Documentation of the area in which the birds were captured is absolutely necessary for response and assessment phases of the spill. Information that must be reported includes the time and dates of capture, name of capture team, capture site (preferably the GPS location), species information, and any medical treatment that was given prior to transport This is the beginning of the individual bird's record, which will follow the animal through all stages of the process.

(5) Field Transport: On initial capture, animals may be placed in pillowcases or similar cloth bags. However, for transport or long term holding, animals should be placed in the proper carrier. It is critical that the animal transport container provides adequate ventilation to reduce or prevent the toxic effects of the volatile components of the oil, while also providing protection from the environment (weather, direct sun), other animals, a visual barrier to reduce stress, and enough space to provide reasonable comfort. When using pet carriers or boxes, more than one animal can be placed in a box if compatibility, relative health, and strength are considered, however issues dealing with cross contamination of animals by the product must be kept in mind. Murres are social and non-aggressive and can be placed with one to two conspecifics for transport. Efforts should be made to minimize noise during transport to reduce additional stress.

(6) Dead Animal Removal: Dead oiled animals should be removed from the environment to avoid contaminating scavengers. Proper documentation including date, time, location, and finder's name should be recorded and attached to the carcass for use in the Natural Resources Damage Assessment (NRDA) phase.

C. Primary Care Requirements

1. Background

The next phase of the operation is primary care, which is the methodology for ensuring that oiled birds are 'stable' prior to transportation to an established rehabilitation facility, often done in the field or temporary facility close to the spill area and should be provided for oiled birds that are likely to remain in the field longer than 2-3 hours (International Alliance of Oiled Wildlife Responders, 2003). The goal of primary care is to stabilize the animals in the field to combat and reduce the short-term toxic effects from exposure to petroleum products. It is essentially first aid and should not include the collection of blood samples and washing (when crude oil is spilled). The primary care team should have

knowledge of how to properly clear the mouth, nostrils, and eyes of oil, regulate the animals' temperature, and treat for rehydration by gavage feeding the appropriate electrolyte and possibly, nutritional solutions.

Primary care is needed when the transport time to the central rehabilitation facility is greater than 2-3 hours. If there is not a rehabilitation facility in place, primary care is absolutely necessary in order for birds to receive immediate care while the facility is identified and modified to accommodate oiled wildlife.

2. Critical Components:

a) Personnel Requirements: Teams of at least two rehabilitation personnel with knowledge of general husbandry techniques, which include gavage feeding and physical exam. If multiple primary care centers are used, one coordinator should be identified; otherwise these activities are carried out under the direction of the intake coordinator at the rehabilitation facility.

b) Experience and Training: The QR will provide trained, experienced, staff to oversee, conduct, and lead the primary care efforts. Personnel must be OSHA certified, or have the equivalent hazardous materials training necessary for working in the zone where the primary care facility is located. The personnel should have the appropriate level of medical training and rehabilitation experience to perform the needed critical actions. The QR will supply personnel that have the appropriate veterinary training and experience to make proper decisions concerning the euthanasia of severely debilitated animals.

c) Equipment:

(1) Human safety equipment: Proper PPE such as tyvek suits, nitrile gloves, safety glasses and first aid kits.

(2) Medical Supplies: Exam table(s), microwave or other method to warm fluids, rectal thermometers, water-soluble lubricant such as KY jelly, stethoscope, bandage material, sterile saline, eye wash, oral electrolyte solution, tube feeding materials - assorted syringes (10-60 ml), Foley catheters (12-16 gauge), Toxiban® or Pepto Bismal, and cotton swabs.

(3) Physical Facility (temporary or permanent) Requirements: Heat control (must be able to maintain 65-85°), ventilation (10-15 air exchanges per hour if possible), shelter from elements, electricity, lights, and water. Space is needed for holding boxes or cages of animals prior to transport plus room to perform animal treatment.

Note: Any identified facility should consider cross contamination issues between domestic and wild animals as well as zoonotic diseases.

d) Specific Responsibilities:

(1) Gross Oil Removal: Remove oil from eyes, nares, and glottis, and flush the eyes with saline.

(2) Temperature stabilization: Assess body temperature and treat birds with less than 101° by warmth and birds with a temperature greater than 106° by cooling.

(3) Treatment for dehydration: All birds should be considered 5% dehydrated and be rehydrated by gavage feeding with warmed electrolyte solutions (50 ml/kg body weight Pedialyte warmed to 100° F). If significantly dehydrated or debilitated, other methods of administering sterile, medical grade fluids should be used (IV, SQ). The bird should be allowed 15-30 minutes of rest prior to being transported to reduce the chance of regurgitation.

(4) Treat toxic effects: Birds should be given an activated charcoal/kaolin mixture (Toxiban®) or other enteric coating agents (Pepto Bismal) in order to block absorption of toxic components and/or to adsorb some of the potential toxins and allow them to pass through the GI tract unchanged. The standard protocol for the Toxiban® mixture is to add 500ml Pedialyte (or other electrolyte solution) to 2 bottles of Toxiban® and given at a volume of 50 ml/kg.

(5) Treatment of traumatic injuries: First aid treatment of wounds, fractures and other injuries requiring immediate attention should be provided. The QR will have staff that is trained to stabilize fractures using standard coaptation techniques, wound cleaning, and knowledge of the measures taken to stop bleeding.

(6) Initial Triage: If personnel are qualified, humane euthanasia may be warranted at this phase (A written euthanasia policy should be established.).

(7) Records and Identification: All procedures should be noted on initial care records, and all animals should be individually identified (via banding or marking prior to transport).

(8) Rest: Once the above procedures are complete, the birds should be placed in quiet, well-ventilated boxes or cages with minimal disturbance to reduce additional stress.

D. Transport Requirements

1. Background

The QR is also responsible for transportation of oiled wildlife. Transport is the method and procedures by which animals are moved from one site to another by vehicle (International Alliance of Oiled Wildlife Responders, 2003). Safe and effective transport increases the chances of maximum survivability of captured birds. A well-organized system will

minimize stress, reduce transport time, and provide necessary supportive care. Transport is needed immediately after stabilization, or as needed when animals are collected.

Ideally, capture, stabilization, rehabilitation, and release would all take place within a few miles of each other, but that is rarely the case. When done properly, animals can be moved significant distances (5 hours for stabilized birds, i.e.: birds that have stable body temperature, have had eyes, nares and mouths cleared of oil, and have received at least one parenteral fluid treatment (International Alliance of Oiled Wildlife Responders, 2003)), but there is a correlation between stress and transport. It is felt that longer transport time increases the amount of stress of individual birds and can affect their chances of survival. There are 12 oiled wildlife rehabilitation facilities and eight permanent stabilization facilities located throughout the coast of California to limit the transport time no matter where the spill may have occurred.

Preferably, captured birds will be taken to a remote site stabilization facility to be stabilized prior to transport to the rehabilitation facility. In some circumstances, such as an oil spill in a remote location off the coast of Washington, stabilization may not be possible and oiled birds may be put into appropriate boxes and transported via air or sea to the rehabilitation facility. In this circumstance, the only means of stabilization will most likely be to provide a warm, dark, and quiet place. The more stable the animal prior to transport, the higher chance the animal will arrive alive to its destination.

2. Critical Components:

a) Personnel Requirements: There needs to be enough personnel to provide transportation of collected animals from S&C to primary care and from primary care to the rehabilitation facility. Transport may require an assigned Coordinator if multiple personnel are needed; otherwise they can be under the direction of the S&C or Primary Care Coordinators.

b) Experience and Training: Transport personnel need adequate driving skills, knowledge of bird behavior, emergency animal care procedures, the geographic area, and hazardous safety information.

c) Equipment Needed:

(1) Transport vehicles: Can include cars, trucks, vans, boats, planes, and helicopters. All must be well ventilated and temperature controlled. The inside temperature should be kept at a temperature that will allow affected animals to maintain a normal body temperature, and oiled birds should be monitored for signs of chilling or overheating. The decibel level of the transport vehicle should also be taken under consideration, and transport times in loud vehicles such as helicopters should be short in duration.

(2) Communication: Cell phones and/or VHF radios are needed to remain in contact with the rehabilitation center, S&C, primary care, and other transporters at all times

so that departure and arrival times are known, and provide up to date health status on the transported animals.

d) Specific Responsibilities:

(1) Transport Containers: All containers must provide enough room for the bird to comfortably turn around; must have proper ventilation so that fumes and heat can escape; must be secure and keep the bird inside from injuring birds or handlers; and must provide visual barriers to reduce stress. Plastic pet carriers are commonly used because they have many ventilation holes, are sturdy, and can be cleaned between animals. Sturdy cardboard boxes can also be used as long as a minimum of 8 one-inch holes per side are punched into them to allow for proper ventilation (International Alliance of Oiled Wildlife Responders, 2003). Freshly oiled birds may emit hydrocarbon vapors, therefore there has to be enough airflow to protect both humans and animals from inhaling the vapors, while keeping the vehicle at the proper temperature.

(2) Container capacity: It is best to transport one bird per container, but when proper transport containers are in limited supply, social species (such as murres), can have 2-3 animals per container.

(3) Supportive Care: If birds have been stabilized prior to transport, transport times of up to 5 hours can be accomplished with monitoring only. If transport exceeds 5 hours, animals should receive one gavage feeding of warmed oral electrolyte solution (International Alliance of Oiled Wildlife Responders, 2003). If the animal's condition deteriorates suddenly during transport, the response veterinarian should be contacted for advice.

(4) Documentation: Paperwork and data generated during S&C and primary care needs to accompany all animals, with birds identified individually as to location collected and treatment received.

E. Rehabilitation Requirements

1. Background and General Requirements

The QR is also responsible for managing the Bird Rehabilitation Center and performs under the protocols established under these guidelines. Rehabilitation is the process of caring for oiled wildlife, using established husbandry and medical protocols, which includes intake, pre-cleaning care, cleaning, pre-release care, and subsequent release of healthy animals to their natural habitat in the wild. The QR will need to have the knowledge and skills necessary to rehabilitate oiled wildlife in the best achievable manner for the highest percentage of oiled wildlife to be released. The WDFW, as well as the Responsible Party, will be responsible for all infrastructure needed to carry out the rehabilitation of the affected wildlife. The QR is responsible for all aspects of animal care, will provide an experienced oiled wildlife veterinarian to oversee medical care of affected

animals, coordinate release of rehabilitated wildlife, and maintain proper chain of custody as well as evidentiary documentation

There should be a licensed veterinarian, with oil-spill experience, available to provide medical supervision during a response. The supervising veterinarian does not necessarily have to be physically present during all bird treatment and care actions. Primary responsibilities include joint decision-making with rehabilitation personnel on animal care, use of controlled substances such as chemical euthanasia solution, necropsy supervision, triage and pre-release evaluation, and overseeing the collection and quality of medical information.

All staff and oiled wildlife rehabilitation volunteers working at the Bird Rehabilitation Center should have hazardous communications (HAZCOM) training necessary for working with oiled wildlife within the facility and the ability to interpret a Material Safety Data Sheet (MSDS) on the petroleum product spilled (Tseng, 1999). Rehabilitation Managers should have knowledge of and be trained in the following categories: Incident Command System, Hazardous Waste Operations and Emergency Response (HAZWOPER), oiled wildlife rehabilitation skills, crisis management, supervisory training, first aid/CPR, and media relations (USFWS, 2001). Search and collection personnel should be trained in the following categories: Incident Command System, Hazardous Waste Operations and Emergency Response (HAZWOPER), oiled wildlife rehabilitation skills, and first aid/CPR. Other rehabilitation workers should have HAZCOM training, as well as basic oiled wildlife rehabilitation and bird washing skills.

2. *Intake*

a) Background

Intake is the process where the oiled birds are admitted into the rehabilitation facility and the collection of pertinent information as well as a thorough animal evaluation is performed. If primary care did not happen in the field, this is also the initial treatment and stabilization phase with the addition of obtaining the animal's weight and blood samples. This phase of the operation begins once birds arrive at the facility and continues until the search and collection effort is stopped.

Each oiled bird must have an individual record that includes the collection location, date and time of capture, the type of oil, degree of oiling, the areas oiled, the bird's weight and body temperature, percent dehydration, and presence or absence of heart and lung sounds. The bird species, sex, and age (if possible) should also be included, and a temporary identification band should be placed on the leg of each bird (if not done at the primary care facility) with the band number noted on the individual's record.

A blood sample should be taken upon intake to the rehabilitation center in order to evaluate the individual's health. Evidence of oiling (such as a feather sample and photograph) should also be collected in order to provide evidence for post-spill damage assessment phases and as proof to the oiling condition of the animals collected.

After the above procedures are done, the bird should be given a slurry of Pedialyte and either an activated charcoal/kaolin mixture (Toxiban) or other enteric coating agents (Pepto Bismal) in order to block absorption of toxic components and/or to adsorb some of the potential toxins and allow them to pass through the GI tract unchanged (Tseng, 1999).

b) Critical Components:

(1) Personnel Requirements: Personnel (working in teams of at least two) must have knowledge of physical exam methods and techniques, be able to identify health problems that may be encountered, be able to correctly speciate affected animals, and determine, when able, age and sex, collect evidentiary information, and provide basic rehabilitation care (i.e. gavage feeding). On average, animal intake evaluations should take no longer than 10 minutes, thus one team of two at each station could intake approximately 60 birds per day.

(2) Experience and Training: The QR will provide trained, experienced staff to oversee, conduct, and lead the intake and physical exam procedures with appropriate hazardous materials training necessary for working with oiled wildlife within the rehabilitation facility. The personnel should have the appropriate level of medical training and rehabilitation experience to perform the needed critical actions. The QR will supply personnel that have the appropriate veterinary training and experience to make proper decisions concerning the euthanasia of severely debilitated animals.

(3) Equipment Needed:

(a) Human safety equipment: Proper PPE such as tyvek suits, nitrile gloves, safety glasses, and slip resistant boots.

(b) Medical Supplies: Exam table(s), microwave or other method to warm fluids, rectal thermometers, water soluble lubricant such as KY jelly, stethoscope, bandage material, sterile saline, eye wash, electrolyte solution, tube feeding materials - assorted syringes (10-60 ml;, Foley catheters - 12-16 gauge), Toxiban® or Pepto Bismal, blood sampling and laboratory equipment, and cotton swabs.

(c) Non-medical supplies: Camera (non-digital, instamatic's are commonly used), scales to weigh animals, aluminum foil, permanent markers, and tape.

(d) Physical Facility (temporary or permanent) Requirements: Heat control (65-85°), ventilation (10-15 air exchanges per hour), electricity, lights, and water. Space is needed for holding boxes or cages of animals prior to intake plus room to perform animal treatment.

(4) Specific Responsibilities:

(a) Animal Exam Form: Information collected on each animal must include: spill name, admission number, date of admission, species, capture site, temporary leg band number, final disposition, and date of final disposition.

(b) Animal exam: A complete physical exam that includes type of oil, percent of coverage, animal age, weight, temperature, dehydration status, and physical exam results.

(c) Treatment Record: A list of dates of all medications given, the date the animal was cleaned, and any other medical procedures required should be established for each individual.

(d) Collect evidence: A feather sample and photograph should be taken; the photograph should include the entire bird, and be labeled with the band number, name of spill, date of admission, species, and admission number. The feather sample should be stored in non-petroleum based covering (i.e. foil), properly labeled, and kept frozen if possible. Evidence of oiling is collected in order to provide evidence for post-spill damage assessment phases and as proof to the oiling of the animals collected.

(e) Blood Sample: A small amount of blood should be taken to obtain, at minimum, the packed cell volume (PCV), total protein (TP), and blood glucose (BG) values.

(f) Primary Care if not performed in the field:

(i) Gross Oil Removal: Remove oil from eyes, nares, and glottis, and flush the eyes with saline.

(ii) Temperature stabilization: Assess body temperature and treat birds with less than 101° by warmth and birds with a temperature greater than 106° by cooling.

(iii) Treatment for dehydration: All birds should be rehydrated by gavage feeding with warmed electrolyte solutions or other methods (IV, SQ) if significantly debilitated.

(iv) Treat toxic effects: the birds should be given an activated charcoal/kaolin mixture (Toxiban®) or other enteric coating agents (Pepto Bismal) in order to block absorption of toxic components and/or to adsorb some of the potential toxins and allow them to pass through the GI tract unchanged.

(v) Treatment of traumatic injuries and triage: first aid treatment of wounds, fractures and other injuries requiring immediate attention should be provided. The QR will have staff that is trained to stabilize fractures using standard coaptation techniques, wound cleaning, and knowledge of the measures taken to stop bleeding and will be available to perform humane euthanasia when warranted.

(vi) Rest: once the above procedures are complete, the birds should be placed in net bottom pens in a quiet, well-ventilated room with minimal disturbance to reduce additional stress. Newly admitted birds should be housed together if possible.

(g) Triage Considerations: Triage is defined as the process by which impacted birds are categorized as to treatment priority and degree of rehabilitation effort (International Alliance of Oiled Wildlife Responders, 2003). In large-scale spills where the number of impacted animals exceeds, or is close to exceeding, the capacity of the rehabilitation facility or there are not enough experienced wildlife specialists to properly treat the affected animals, triage is critical to allow the effective use of resources on those animals that have the best prognosis. In order for a successful rehabilitation effort to be carried out, herd health has to be considered to treat those animals with the greatest probability of survival.

Poor risk animals include birds having red blood cell counts 20 percent less than normal, extremely low protein and/or body condition, and consistent body temperatures less than 100° F (International Alliance of Oiled Wildlife Responders, 2003). Birds that come in with serious injuries, infectious diseases, and pronounced neurological signs have poor prognosis and euthanasia may have to be considered. The degree of oiling, the temporary presence of bleeding from the GI tract, and molting are not considered adequate grounds for euthanasia (International Alliance of Oiled Wildlife Responders, 2003). Threatened or endangered birds, species with small population sizes, and species with low reproductive potential may need approval by Federal or State agencies prior to euthanasia.

Chemical euthanasia methods are recommended and are the preferred method. Most euthanasia solutions are restricted drugs and subject to control by the Drug Enforcement Administration (USFWS, 2001). An experienced oiled wildlife veterinarian, Registered Veterinary Technician with oiled wildlife experience, or experienced oiled wildlife rehabilitators should carry out the triage process.

3. Pre-cleaning Care

a) Background

Pre-cleaning care is the husbandry care given after intake until the animal is deemed stabilized for cleaning. This phase of the response operation begins when animals start to

come through intake and lasts until all animals are washed. All birds at this stage need nutritional as well as hydration support. Birds with normal PCV and total protein values greater than 2.0 g/dL are gavage-fed high calorie nutritional slurries up to four times a day with alternating rehydrating solutions resulting in up to eight gavage feedings per day per bird (OWCN, 2000, Tseng, 1999). In general, a bird can accommodate about 50 mL/kg BW (Tseng, 1999). Birds with low total protein values are given human enteral products (Ensure® Ross Labs) because it is an easily digestible diet and felt to allow more efficient absorption of calories (Tseng, 1999).

The washing and rinsing procedure is one of the most stressful and rigorous steps in the rehabilitation process, and birds that are not medical stable prior to wash often die (Mazet, et al., 2002). Stabilization usually requires 48 hours of indoor care (Mazet, et al., 2002), and pre-wash assessment must indicate a fairly normal health evaluation before washing takes place. The birds must have a stable core body temperature, weight gain or stabilization, normal hydration status, normal neurological signs (e.g., bright, alert, and responsive), and results of biomedical testing that show a stable bird. Current OWCN protocols require birds to have PCV values greater than 30% and total protein greater than 25 g/dL because, through experience, those birds at lower levels often have problems during the wash. One hour prior to washing (to avoid regurgitation/aspiration), birds are gavage fed one fluid and one nutritional treatment to sustain the birds throughout the cleaning process.

b) Critical Components:

(1) Personnel requirements: Enough rehabilitation staff trained in husbandry care and gavage feeding is needed to keep up with the volume of birds arriving from intake (approximately one staff for every 10 birds). This area within the spill response often has the greatest need for personnel; however, volunteers can greatly supplement the staffing for this section. One Coordinator should be identified to oversee care.

(2) Experience and Training: The QR will provide trained, experienced, staff to oversee, conduct, and lead the pre-cleaning care with the appropriate hazardous materials training necessary for working with oiled wildlife within the rehabilitation facility. The personnel should have the appropriate level of rehabilitation experience to perform the needed critical actions.

(3) Equipment:

(a) Human safety equipment: Proper PPE such as tyvek suits, nitrile gloves, safety glasses and first aid kits.

(b) Husbandry Supplies: electrolyte solution, human elemental solution i.e. Ensure, tube-feeding materials - assorted syringes (10-60 ml), Foley catheters – 12-16 gauge, Toxiban® or Pepto Bismal, appropriate animal food, scales to weigh animals, blood collection and laboratory supplies, and cleaning supplies (hoses, towels, floor squeegees, and disinfecting solutions).

(c) Physical Requirements: Appropriate housing for the species impacted (i.e. net bottom pens for murres); one raised 4' X 8' pen can house 20 oiled murres (pers. comm. Deirdre Goodfriend), heat control (able to maintain temperature between 65 and 85°F), adequate ventilation (10-15 air exchanges per hour), and sufficient electricity, lights, and water.

(4) Specific Responsibilities:

(a) Gavage-feed alternating high calorie nutritional slurries and rehydrating solutions (an average of up to eight gavage feedings per day).

(b) Monitor animal health daily (including daily weight checks) and provide information to responding veterinarian.

(c) Keep area clean to reduce the spread of pathogens.

(d) Perform pre-wash exams: collect blood and assess approximately every two days.

(e) Properly document all pertinent information i.e. feeding times and amounts eaten, blood work and health evaluation results.

4. Indoor Housing

a) Background

Indoor housing with proper ventilation is preferred to outdoor housing during this phase because it facilitates monitoring, is a controlled environment, provides protection from predators, and is secure. The indoor housing for murres (as well as loons, grebes, and sea ducks) should be on "net bottom" caging because these are aquatic birds that are not accustomed to placing pressure on certain points on their bodies, especially their keels and hock joints (OWCN, 2000). The nets on the bottom of these pens should be knotless, easy to clean and disinfect, and should be at a fine enough mesh size (1/2 to 3/4 inch) to allow feces to drop through without leg and/or foot entrapment. Seabirds require their feathers to be 100 percent waterproof upon release, therefore, their caging must not cause any additional damage other than the oil has caused. Caging with improper air circulation, padding, and drainage can cause feather damage, as well as keel and hock sores (Goodfriend, 1997). The use of cotton netting as the bottom surface of the pen prevents most of these problems, but only for a short amount of time. When animals are

not moved into outdoor pools within one week, feather damage and/or keel and hock lesions can occur.

Minimum housing standards for Alcids that are 20-30" in height are 36"X 36" X 36" for temporary confinement, and 4'X 4'X 4' for recovery (NWRA/IWRC Wildlife Rehabilitation Minimum Standards, 1993), and the most common type of indoor housing used in oiled bird rehabilitation facilities are raised 4' X 8' net bottom pens made out of sheets of plywood preferably painted with non-toxic paint. During the pre-cleaning phase, approximately 20 oiled murres can be housed per pen (pers. comm. Deirdre Goodfriend).

5. *Cleaning and Drying*

It is critical to have the wash facilities ready as soon as birds have met wash criteria, because the longer that oiled animals have to wait, their chance for release decreases. There is only a short window of opportunity that the birds have before they begin to experience the secondary effects of oil, which result from prolonged periods of time in captivity (OWCN, 2000). As birds wait, their chances of developing aspergillosis (a fungal respiratory disease), anemia, and/or other disease processes derived from captive stress increases. Holding aquatic species out of water for too long will also lead to the development of pressure sores over the keel, hock joints, and feet. Once these sores develop they are difficult to treat and euthanasia may have to be considered.

a) Background on Cleaning

Cleaning is the removal of contaminants from the integument (skin and feathers) of the oiled animal to allow restoration of that animal's normal thermoregulatory process (International Alliance of Oiled Wildlife Responders, 2003). The goal of the cleaning process is to quickly remove the petroleum that is compromising the animal's ability to survive in the wild, and to minimize the time spent in captivity due to waterproofing issues and the associated thermoregulatory problems (International Alliance of Oiled Wildlife Responders, 2003). The QR would accomplish this task by utilizing proven cleaning methods and protocols.

The cleaning phase usually begins 48 hours after the first birds begin arriving to the facility (if cleaning stations are set up) and lasts until all viable birds are cleaned. Most birds are cleaned within two to four days after arrival (with the goal of cleaning animals 48 hours after intake), but unstable birds may remain in this phase for longer periods with the caveat that longer holding times can increase the potential for secondary husbandry problems. Euthanasia should be considered for birds unable to meet the wash criteria after ten days.

There are critical personnel, equipment and facility requirements for the cleaning process to take place. It is crucial to have personnel experienced in washing procedures because the higher level of experience, the faster the wash process will be completed, thus reducing the time the animal is under severe stress. The critical equipment and facility

requirements include the ability to deliver 100-300 gallons of softened water (tested at 2-3 grains of hardness) consistently heated to 104-106° at 40-60 psi. On-demand hot water heaters, water softening and testing equipment and the proper spray nozzles need to be on site and in proper working order within 2-3 days of the spill. Diluted Dawn dishwashing liquid, has been proven to be the most effective detergent to remove oil (Bryndza, 1990), however, other dishwashing liquids can also be used with very good results. Other cleaning agents should not be used due to potential damage to feathers and/or skin.

b) Discussion of Alternative Washing Methods

The development of machines to wash oiled birds has been a much discussed topic since the first bird was washed. A number of prototypes have been produced with varying results. Cost-effective machines that can safely and consistently restore oiled birds to a waterproof state in a timely fashion, and at the same time, minimize stress and handling would be a valuable tool. However, none have yet to be shown successful in reaching that goal (International Alliance of Oiled Wildlife Responders, 2003), and due to the dynamic nature of the cleaning process, may not be an attainable objective.

(1) Elf Bird Washing Machine

The bird washing machine developed by Elf and Jean-Pierre Jacques of "CHENE" Oiled Bird Rehabilitation Center in France is the only machine currently on the market. It has been utilized in a number of recent oil spills including the *Pallas* in Germany (1999) and the *Erika* in France (2000). Observation of the machine in operation and of some of the birds washed utilizing the machine have led to the voicing of concerns by colleagues regarding the efficacy and safety of the machine. These concerns have centered on injuries that appear to be caused by the restraint devices as well as the lack of timely waterproofing observed in birds cleaned utilizing the machine. The machine has not been shown to meet the goals stated above in a satisfactory manner and is not at this time recommended as an accepted method by most oiled bird response organizations (International Alliance of Oiled Wildlife Responders, 2003).

(2) Magnetic Cleaning

John Orbell and colleagues at Victoria University of Technology (Australia) have proposed the use of iron powder for removing oil from birds. Laboratory experiments with individual feathers have demonstrated the ability of iron powder to adsorb oil from feathers, with the iron powder and oil then removed with magnets. The method has yet to be utilized in field trials. Previous attempts to use powders for cleaning have been unsuccessful due to the difficulties of distributing powder to all feather surfaces. There is also concern regarding inhalation or ingestion of the powder by the treated animals or humans (International Alliance of Oiled Wildlife Responders, 2003).

c) Background on Drying

After cleaning, birds are dried by warming the ambient air temperature in the drying pens to 90°-95° F with commercial pet dryers, or other heat sources (Tseng, 1999). The drying pen consists of an enclosed space with a heat source (such as a pet dryer(s)) being placed to distribute warm air throughout the chamber. Temperature in the drying pens can be somewhat adjustable through the placement of sheets or towels over openings. The pens used for drying are usually the same design as pre-wash holding pens, but fewer birds are housed to allow air to completely surround animals (i.e. only 12 birds are kept in the raised 4' X 8' space (pers. comm. Deirdre Goodfriend)).

During the drying process, the bird must be monitored frequently and observed for signs of hyper- or hypothermia. Once dry, birds can quickly overheat. Birds can also be dried with heat lamps if the drying pen is large enough so the birds are able to stand and move away from the lamp if they become too hot. It may take 1-3 hours for the bird to dry depending on the species and birds should be completely dry down to the skin before being exposed to the ambient temperature or moved to an outdoor pool.

> Note: The exception to this is small shorebirds which are always dried under a heat lamp. These less densely feathered species can dry very quickly (10-15 minutes) (per. comm. Deirdre Goodfriend).

d) Critical Components:

(1) Personnel Requirements: All animals should be cleaned by teams of at least two people (one handler and one washer); birds are never washed alone. Large birds such as pelicans, swans, and geese often require three or more people; even tiny shore birds require a washer and someone to monitor water temperature and otherwise assist the washer (pers. comm. Deirdre Goodfriend).

(2) Experience and Training: Experienced staff is vitally important with this phase. The higher level of experience, the faster and more effectively the process will be complete, which will reduce the time the animal is under severe stress.

(3) Equipment:

(a) Human and Safety Equipment: All wash and rinse personnel must wear proper PPE, which includes safety goggles, waterproof covering over clothes, long oil repellant gloves, and rubber boots. Concerns regarding potential heat stress of personnel are of particular importance in this area due to heat, humidity, and length of time standing still.

(b) Physical Requirements:

(i) Wash/Rinse:

(a) 100-300 gallons of soft water (tested at 2-3 grains of hardness) consistently heated to 104-106° at 40-60 psi per bird. (These parameters must be kept consistent at each wash station throughout the wash day).

(b) On-demand hot water heaters, or equivalent, that will keep up with the considerable quantities of hot water needed for washing and rinsing.

(c) Dawn® dishwashing liquid or other dishwashing detergent.

(d) Water softening and testing equipment

(e) Thermometers (to monitor water temperature)

(f) Multiple 5 to 25-gallon containers for washing birds

(g) Adjustable, high-pressure spray nozzles (40-60 psi.)

(h) Toothbrushes and Water Pik's® to gently remove oil from the face and head

(i) Towels

(ii) Dry:

(a) Commercial, heavy-duty pet dryers and/or heat lamps

(b) Net bottom pens

(c) Sheets to cover pens

(4) Specific Responsibilities:

(a) All birds must be stable prior to wash.

(b) The water quality for washing and rinsing should be 2-3 grains of hardness, 104-106°F, and be at 40-60 psi.

(c) Dawn dishwashing liquid or similar product, diluted to 1-2%, has been proven to be most effective to remove oil.

(d) The birds are dried in clean, net bottom drying pens in which the ambient air temperature is heated with a pet dryer (or other method) to 90-95°F. The birds remain in these pens until dry.

6. Post-cleaning Care

a) Background

Post-cleaning care is the process of caring for the animals after wash and allowing them time and nourishment to reestablish normal and ecological health parameters that are required for the birds to be released. The health and behavioral parameters that each bird should meet prior to release are: the bird has to be 100 percent waterproof, have normal swimming and diving behaviors, show fear of humans, and have a normal physical examination, which shows no active disease states, all injuries healed (or at a stage that will not interfere with normal foraging), and have normal blood values (International Alliance of Oiled Wildlife Responders, 2003; Tseng, 1999). This phase of the operation takes place from after the cleaning and drying process until ready for release, which last on average 5-14 days post-cleaning.

Having personnel experienced in observing normal bird behavior and who are careful to watch for signs of hypothermia are critical during this time. Knowledge of assessing waterproofing comes only with experience, and those birds that are not waterproof need to be quickly identified, examined to determine the cause, dried using species appropriate methods, and a plan devised to resolve the problem. Causes may include inadequate wash or rinse, weeping wound, feather damage, or improper preening. Experience is needed to identify and correct such problems before further complications arise.

Once outside, aquatic species should be housed in enclosures appropriate for the species and allows as close to natural activities as possible. For most aquatic birds (including alcids), pools at least twelve feet in diameter and thirty-six inches deep (with a preferred pool depth of four feet) should be used in order for the birds to condition themselves for release (Tseng, 1999). The walls of the pool should extend above the depth of the surface of the water by at least two feet in order to decrease visual stimulus and discourage escape (Goodfriend, 1997). Clean, fresh water is used in the pools, and, when possible, waterproof birds should be housed in softened water for the first 24 hours. When birds are permanently housed in outdoor pools the amount of handling dramatically decreases. Gavage feedings for hydration and nutritional support are no longer necessary because the birds can acquire water directly from the pools as well as self-forage on fish (preferably smelt) that are tossed into the pools. It is important to monitor the feeding success and weight of individual animals to ensure proper nutritional requirements are being met. Using the 1 kg common murre, 15 clean birds can be housed in a 12 foot diameter pool (pers. comm. Deirdre Goodfriend).

b) Critical Components:

(1) Personnel Requirements: Enough trained personnel are required to monitor waterproofing with specific experience in observing normal behavior of birds such that signs of hypothermia, disease, or injury are identified as quickly as possible. One Coordinator/Supervisor should be identified to oversee care.

(2) Experience and Training: Aquatic bird experience is very important with this phase, as identification of lack of waterproofing can be difficult to accomplish without prior experience. Also, personnel must be knowledgeable of pool and water systems, bird ecology (to determine species appropriate housing) and animal examination skills (to assess for release).

(3) Equipment:

(a) Human Health and Safety: PPE includes eye protection and rubber boots. Non-powdered exam gloves may be used for exams.

(b) Husbandry Supplies: Long handled nets and towels, blood collection supplies, scale, animal food, and clean boxes for animal handling and moving.

(c) Physical Requirements:

(i) Enough clean water (to fill the pools and to maintain an overflow of at least 10 gpm), preferably with control over hardness in at least a subset of the pools.

(ii) Pools for aquatic birds should be permanent or KD pools (or similar); 12-16' in diameter filled 4' deep

(iii) Garden hoses

(iv) Recirculation pumps and filters (if available)

(v) Manual pool siphoning and cleaning equipment

(vi) Haul out areas inside the pool

(vii) Net cover to deter animal escape

(4) Specific responsibilities:

(a) Dry aquatic birds are tested for waterproofing by placement into clean, fresh water swimming pools. If waterproof, the birds will not display visible signs of chilling, such as shivering, agitation, riding low in the water, excessive preening, and/or attempting to haul out. If waterproof, the birds remain in the outdoor

holding pools; if not waterproof the birds are brought back inside to dry, the waterproof problems is addressed, and then returned in pools.

(b) Monitor animals in outdoor pools through behavior observations, regular weighing, and physical examinations.

(c) Supply birds with fish or appropriate food throughout the day.

(d) Once permanently housed outside, physical handling of the animals is dramatically reduced. The animals can self feed on fish tossed into the pools as well as hydrate with pool water.

(e) The pools are cleaned at least once a day by netting out large debris and siphoning out fine debris.

(f) Determine when individual animals are ready for release. The animals must:

(i) Display normal behavior

(ii) Be within 10% of normal body weight

(iii) 100% waterproof

(iv) Have a normal blood values

(v) Have a normal physical exam

7. Release

a) Background

Release is the return of rehabilitated wildlife back into their natural, unoiled environment so that they are able to resume their place in the ecosystem (International Alliance of Oiled Wildlife Responders, 2003). These animals must be fully functional and capable to compete with conspecifics in the same manner as prior to being affected by the oil (International Alliance of Oiled Wildlife Responders, 2003). The overall goal of animal care is to return the highest percentage of rehabilitated animals back to their natural homes; however, animals should not be released unless there is a good chance that the animal will survive and flourish in their habitat. This phase usually starts from one to two weeks after intake and lasts until the end of the operation.

All birds will receive a permanent United States Fish and Wildlife Service metal leg band prior to release. Additional post-release monitoring should be strongly considered during spill events because it can help verify the long-term success of released animals, therefore providing critical data to evaluate the overall effectiveness of the response effort.

Release sites should be selected based on being free of ongoing contamination but close to the area where the animal was collected to minimize transport time in order to reduce the stress associated with transport. The yearly migration pattern of the species and species appropriate habitat should also be considered (International Alliance of Oiled Wildlife Responders, 2003).

b) Critical Components:

(1) Personnel requirements: There should be enough personnel to provide transport of the animals back to or near to the original collection site. Thought should be given to allow staff and volunteers to participate in release events to keep morale and spirits high during the response.

(2) Experience and Training: Release personnel should have driving skills, bird behavior and ecology, and media training. They should also have the ability to communicate with the rehabilitation center.

(3) Equipment:

(a) Transport vehicles: These can include cars, trucks, vans, boats, planes, and helicopters. All must be well ventilated and temperature controlled. The inside temperature should be kept between 65 and 70° F, and the birds should be monitored relatively frequently for signs of hypo- or hyperthermia.

(b) Communication: Cell phones and/or VHF radios are needed to remain in contact with the rehabilitation center to provide up to date health status on the transported animals (if needed).

(c) Containers: sufficient numbers are needed to transport one bird per container to avoid overcrowding and subsequent contamination of feathers with fecal matter.

c) Specific Responsibilities:

(1) Safely transport animals to approved and appropriate release site.

(2) Release diurnal birds early enough during the day for animals to acclimate before dark.

F. Volunteers

1. Background

A volunteer is any person who provides goods or services without receiving salary or recompensation for time, meals, transportation, lodging, or for other expenses dependent on the degree of the response (International Alliance of Oiled Wildlife Responders, 2003).

Volunteers are critical to the success of an oiled wildlife response. They can range from pre-trained wildlife rehabilitators who have developed specific oiled wildlife skills over a period of time to convergent volunteers who turn up during a large-scale incident in order to offer their help. Rehabilitation work is labor intensive, therefore the use of volunteers to help carry out the work is vital.

Certain provisions are needed for all volunteers: orientation, supervision, training, stewardship, first aid if injured, and support (i.e. food, rest areas). To create a reliable volunteer corps, volunteers have to be treated with respect and believe that their input is important. In order to ensure the continued participation of each individual, volunteers need to take away a sense of worth that what he/she is doing is helping the wildlife, no matter how mundane the job.

The QR will provide training for volunteers in every aspect of work, including cleaning, animals feeding, human health and safety, crisis management, and how to deal with the media and public.

A general orientation for individuals volunteering at a center during a spill should be as thorough as possible. Volunteers need to know about the components of the rehabilitation facility, as well as the overall oil spill response operation, in order to understand their role within the response effort. One way to do this is to provide relevant information to the volunteers prior to the beginning of their shift; this may include background information on the current oil spill, the species and estimated numbers affected, how many animals are at the facility, the number of released animals, why and how oil affects animals, procedures of rehabilitation (including explanation of euthanasia), and jobs that need to be filled at the center.

A complete tour of the facility should be given to all volunteers, as well as how to identify supervisors and trained personnel, and the management structure of the center. The volunteer should also be aware of what to do if injured, who to contact, and which organization (if any) is providing worker's compensation in case they are injured while on site.

The QR will have a volunteer coordinator to support, train, and schedule the volunteer corps. It is critical to provide a coordinator to maintain training continuity as well as provide a key person to go to with questions/problems. The volunteer coordinator acts as a central distributor of volunteer work effort and matches the volunteer skills with the rehabilitation needs for the day. The volunteer coordinator must also be aware of morale issues within the center and its effects on volunteers, must be sure that the volunteers feel they being appreciated for all their hard work, and ensure they are kept involved and informed about all aspects of the rehabilitation effort.

In WA, the use of the ARMS database can be used help organize volunteer efforts. Their name and address, age, and relevant experience can all be entered into the system. This information can then be used to place the volunteer into a rotation to ensure there is a mixture of skills on each shift. The use of ARMS can help manage the number of volunteers, the

skills acquired on each shift, and the upcoming needs within the facility in order for the volunteers to know when it is best for them to return.

Volunteer Information Needed:
Name, address, and phone number (e-mail if available)
Age of the volunteer (minimum 18 years old)
Health of the volunteer
Contact details, next of kin
Most recent tetanus vaccination

G. Oiled Wildlife Rehabilitation Facilities

1. Background

Oiled wildlife rehabilitation facilities can be either permanent (established structures that are either dedicated to supporting oiled wildlife during a spill event or have the innate capacity to quickly be converted over to the use of treating oiled birds, or temporary buildings that are not specifically dedicated to or modified to allow, oiled wildlife rehabilitation. They may include existing buildings or structures that are modified at the onset of a spill for the purpose of oiled wildlife rehabilitation or temporary facilities that are set up and/or built to meet the need of an oiled wildlife response). In most situations, a permanent facility dedicated to oiled wildlife care is considered to be the best approach to a successful response because it eliminates the chaotic search for a building that contains the specific infrastructure necessary for oiled wildlife care, or can be rapidly modified to meet these needs. Timing is critical and birds have a short window of opportunity before the secondary effects of oil begin to take place. Lengthy delays in moving oiled birds through the rehabilitation process decreases their chance for survival. Facilities specifically designed to care for oiled wildlife, in conjunction with the use of established protocols by trained personnel has improved survival rates in California (Mazet, et al., 2002).

In the absence of a permanent purpose-built facility, pre-identification of appropriate sized buildings that an be modified relatively rapidly, or modular units/trailers that can be activated quickly, can provide good support for animal care operations <u>if</u> careful thought and planning is invested in the process <u>and</u> the facility can be rapidly deployed for rehabilitation <u>and</u> if infrastructure in place (i.e. electrical, HVAC) is sufficient to support operations at the level described in this document. Below is a discussion of critical facility components needed to successfully treat oiled birds.

2. Design

The facility should utilize design that maximizes the efficient flow of animals and people through the rehabilitation process, while minimizing the possible spread of disease. For example, the wildlife intake area should be adjacent to the outside in order for the birds to be admitted directly from the transport vehicle; intake should be adjoining to pre-wash holding in order for the birds to be moved there for stabilization; the wash/rinse area

should be set up in between the pre-wash and post-wash holding areas, and post-wash holding should have access to outdoor pools. Food preparation should be centrally located for easy access to all indoor and outdoor holding areas, and allow support of both oiled and unoiled (i.e. "hot" and "cold") areas.

Isolation/ICU should have easy access to the indoor holding area, but should have independent ventilation systems to minimize the spread of pathogens. The morgue/necropsy area can either be entirely separate from the main facility, or be housed in a remote area within the center to reduce the spread of pathogens as well.

3. Space

The dedicated wildlife space can be separated into three main groups: dynamic areas which are dedicated areas where size change with the number of birds in house; semi-static areas which are dedicated areas within a rehabilitation facility where space requirements increase not directly with animal numbers but in a stepwise manner with severity of the spill; and static areas which are dedicated areas within a facility where space requirements do not change with the number of birds in house.

a) Wildlife-Areas

(1) Dynamic areas

For this report, the OWCN derived the dynamic area space needs not on a strict square feet per bird estimate, but on the area needed for each component of the rehabilitation process. This process will allow the Wildlife Branch Director and the QR to create a more accurate estimation of square footage needed in each area. Additionally, these space and capacity estimates are based on the assumptions previously defined, and are designed to apply to a "typical" spill event. Dynamic areas include:

(a) Intake – 1 intake station can evaluate approximately 60 birds/day; each station needs 40 sq. ft. to support animal and human activities.

(b) Pre-wash holding – 20 birds per raised 4'X 8' pen; total space per pen equals approximately 96 sq. ft. (including human workspace). Included in this area would be those animals waiting for intake.

(c) Wash/rinse stations – 1 paired wash/rinse station can wash approximately 16 birds/day; each paired station needs approximately 100 sq. ft.

(d) Drying/post-wash holding – 12 birds per raised 4 'X 8' pen; total spaces per pen equals approximately 96 sq. ft. (including workspace).

(e) Outdoor pools – 15 birds per 12 ft. diameter 4 ft. deep pools; each pool needs approximately 200 sq. ft. of yard space.

(2) Semi-static areas

Semi-static areas within the facilities are those dedicated areas within a rehabilitation facility where space requirements increase not directly with animal numbers but in a stepwise manner with severity of the spill. Space needs might double or even triple in significant events, but could be augmented through temporary additions. The semi-static facility areas include

(a) Food preparation – 300 sq. ft. per 1,000 to 1,500 birds

(b) Morgue/Necropsy – 250 sq. ft. per 1,000 to 1,500 birds

(c) Storage – 100 sq. ft. per 1,000 to 1,500 birds

(d) Freezers – 100 sq. ft. per 1,000 to 1,500 birds

(3) Static Areas

Static Areas within the facility are those where dedicated space needs do not change with the volume of birds. These are areas that are usually dedicated to support of the overall response, and space requirements are dictated by the physical size of the needed equipment, rather than external impacts. The static facility areas include:

(a) Isolation/ICU – 200 sq. ft.

(b) Medical Laboratory – 200 sq. ft.

(c) Laundry – 200 sq. ft.

(d) Electrical – 100 sq. ft.

(e) Mechanical – 250 sq. ft.

b) Dedicated Human Space

Space for human needs should always be taken into consideration and planned for when developing spill contingency plans. The approximate minimum space needs are:

(1) Training – 500 sq. ft.

(2) Rest and Relaxation – 500 sq. ft.

(3) Office- 500 sq. ft.

(4) Restrooms – 200 sq. ft.

As was seen in the semi-static wildlife areas, human space areas will increase as the numbers of personnel increase, and will vary significantly with many factors, including but not limited to the remoteness of the rehabilitation facility, the accessibility of other buildings, and facilities available to conduct non-hands-on animal rehabilitation tasks (i.e. trainings). Therefore, direct application of incremental size increases is difficult to address.

4. Utilities

a) Water

(1) Background

Large quantities of fresh water are needed for the rehabilitation of oiled birds, with a significant portion needing to be heated and softened. Hard water contains calcium and magnesium that cling to the barbules of bird feathers interfering with their ability to interlock and realign, which affects the bird's waterproofing (Cumpner, 1990). The water quality for washing and rinsing should all test at 2-3 grains of hardness, or 30-50 mg calcium carbonate per liter (Clumpner, 1990). In addition, where possible, the pools that the birds are first introduced to should also be soft. Washing and rinsing a one-kilogram bird can take up to 300 gallons of water heated to a bird's normal body temperature (between 104°and 106°F) depending on the skill of wash personnel and the degree the animal is oiled. The best (and often the only) way to maintain this steady stream of warm water for multiple animals being washed simultaneously is with on-demand hot water heaters (Holcomb, 1995). At no time should the water temperature fall below 99°, for if it does, the bird will become cold or hypothermic (Tseng, 1999; USFWS, 2001). The water pressure needed to effectively rinse the detergent from the feathers is 40-60 psi. (Tseng, 1999).

(2) Requirements

(a) Quality: Wash and rinse water should test at 2-3 grains of hardness. Ideally, pools where birds are first put into after cleaning would have softened water, with subsequent movement to harder water as the rehabilitation process continues.

(b) Quantity: A 1 kg bird requires up to 300 gallons water for the wash and rinse process. There must also be a sufficient supply of water to house them in the outdoor pools, with a volume of approximately 3,500 gallons for a 12 foot diameter pool that is 4 feet deep. Other water needs include: pool overflow for surface cleaning, food preparation, laundry, general maintenance and cleaning.

(c) Temperature: Washing and rinsing requires the water to be heated to 104° to 106° F.

(d) Pressure: Water pressure must be able to be delivered between 40-60 psi at the rinse station.

b) Ventilation

(1) Background

In order to keep the oiled birds from becoming cold or hypothermic, the ambient air temperature in oiled bird holding areas should be able to be adjusted between 65° and 85° F because the indoor holding needs may change over time. Early in the spill, all indoor holding will be for oiled birds, where indoor temperatures in the 80°'s will be far too high for clean animals. Late in the spill, the majority of indoor holding will be for clean birds which require temperatures in the 60°'s. Having the temperature in holding rooms adjustable will allow adequate temperatures needed to house either oiled or clean birds (but never together in the same room). This temperature has to be kept while also maintaining a minimum air exchange rate of 10 per hour, which is the National Institute of Health (NIH, 1985) and the Assessment and Accreditation of Laboratory Animal Care recommended rate. Good ventilation is also required for reducing irritating petroleum fumes and to reduce the potential of the birds developing aspergillosis, a fungal disease (Mazet, 2002, Tsang, 1999).

(2) Requirements

(a) Temperature: Air temperature in bird exam and holding areas should be adjustable and maintainable between 65°and 85° F.

(b) Ventilation: A minimum of 10 air exchanges per hour are recommended.

c) Electricity

(1) Background

At least 800 amps (220/3 phase) should be available on site within the facility's infrastructure. However, portable generators can be used to supplement a facility's power capability. As an example of the power needs, each commercial pet dryer draws 11 amps (when set on high), and the drying room needs a 110/20 amp dedicated circuit per dryer. The outdoor yard lighting requires 220-single phase for permanent lighting and 110-single phase for portable lighting. The recirculation pumps for each outdoor tank (to help maintain water quality) need 20-amp 110-single phase dedicated circuit for each pump. All circuits need to be GFIC type for safety because of the moist and wet environments associated with oiled seabird rehabilitation.

(2) Requirements

(a) Amps: 800-1000 amps are often needed to power the entire electrical demand of an oiled wildlife rehabilitation facility, preferably at 220/3 phase.

d) Waste Water

(1) Oiled Waste Water: All oiled or potentially oiled water has to go into an appropriate holding container designed to hold oiled waste for a licensed wastewater handler to remove and treat according to Washington State regulations. Constant monitoring of water level and establishment of hazardous waste removal protocols and policies are necessary. The waste-water should be removed as needed, but the container should hold a minimum of three days worth of water and should sit inside a secondary container to contain overflow, in case of a delay in pick-up.

(2) Other waste water (rinse water, yard): All water that has been in contact with animals needs to go into either sewer or storm drains (depending on local regulations).

e) Other Waste

(1) Oiled Waste: All oiled PPE and other solid waste should be disposed of in a proper receptacle and held for hazardous waste removal following Washington State standards.

(2) Non-oiled waste: Non-oiled waste must be picked up in accordance with local regulations concerning waste removal.

f) Carpentry/ Workshop

(1) Must be far enough away that the birds are not affected by the noise.

(2) A workshop will be needed throughout the rehabilitation effort at a temporary facility, although to a lesser extent as time goes on.

(3) Space will depend on facility needs.

IV. MODELING OF REHABILITATION AND FACILITY NEEDS DURING OIL SPILL RESPONSES

A. Background and Overview of Facility Needs

With an established facility staffed with experienced and trained personnel, the minimum amount of time a bird spends in the pre-wash phase is 48 hours, and the post-wash period can be 5-12 days, therefore, with no unforeseen problems the average time a bird undergoing treatment spends in a facility in California is approximately 9-16 days. For acute spills in either the Puget Sound or off the Pacific coast, with appropriate planning and contingency for facilities and

personnel in place, the rehabilitation effort could be expected to last a similar duration of time. In an acute point-source spill, the highest numbers of oiled birds usually come into the facility within the first week, but search and collection would usually continue for at least 2-3 more weeks. With a spill of this magnitude, response time should not exceed 2 months based on data from previous spills. (See Appendix A for Intake Rates)

Previously in this report, the specific facility elements needed regardless of the number of birds expected to come into the facility were identified. These elements include: oiled bird intake, pre-wash holding space, wash and rinse stations, post-wash holding space, outdoor pools, food preparation room, isolation and intensive care unit, medical laboratory, morgue and necropsy area, and plenty of storage space (USFWS, 2000).

The WDFW asked the OWCN to identify the elements that change in relation to the number of birds in the facility. These elements do not change in the process of rehabilitation, but the demands placed on each element will change throughout the rehabilitation process. Also, depending on the size and severity of the spill, specific areas may share duties (i.e. dirty bird holding used as clean bird holding towards the end of the response).

Once a spill occurs and the search and collection operation begins, the initial emphasis is placed on the oiled bird intake and holding areas. These areas will be the only animal areas in operation for the first 48 hours of the spill (exclusive of food prep and volunteer/staff areas), because, as this report has previously mentioned, oiled birds need at least 48 hours to stabilize prior to washing (Mazet, et al.,2002). On day three, oiled birds can now be washed, therefore the wash and rinse stations need to be operational and a source for fresh, softened, warm water needs to be in place. To follow the established scenario, the facility elements needed for animals on day three are: oiled bird intake and holding, wash and rinse stations, and dry clean bird holding. On this same day, the outdoor pools may be utilized as well. The birds that were washed in the early part of the day three could be placed in outdoor pools in order to determine their level of waterproofing. The birds, however, will most likely not be housed in the outdoor pools overnight, subsequently; enough indoor, dry holding space will be needed for most of the washed birds on night three. Day four, oiled birds continue to come into the facility and the intake and holding areas are being utilized. Oiled birds that came in on day two and some birds from day three are being washed, the birds that were washed on day three and four are being acclimated to outdoor pools and those that are 100 percent waterproof will be permanently housed there.

This flow of birds through the facility will continue for as long as live oiled birds continue to be found. Based on examples from previous spills, the intake of oiled birds peaks within the first week of a response from a point source spill (see Appendix A).

B. Model Development, Methods and Results

One of the main components of this project was to develop matrices or other graphical features that would demonstrate how facility infrastructure and the demand placed on them change in relation to the number of birds needing care within the facility over time. In order to accomplish this task, a dynamic modeling tool developed by the OWCN was used to estimate facility and personnel needs from California spill projections. This tool is a Microsoft Excel spreadsheet that

is composed of: 1) static data pertaining to the flow of animals through the rehabilitation process, 2) imbedded formulas to calculate output values, and 3) dynamic estimators that can be altered to determine how differences in facility, animal and staffing availability, quality and training affects the outcome of a spill response. Much of the information used in the model is contained within this document, with particular emphasis on space and utility needs and how birds flow through a response. Real spill intake data (from several large events in California) was also used to create as realistic a model as possible (Appendix A) , with particular attention given to the staging of animals within each area of the facility over time, estimating normal mortality levels within each area during the spill response, and allowing for the success of only a certain proportion of animals to progress through the rehabilitation process (for example, only a certain number of animals will be stable enough after two days in care to progress to the cleaning phase). Also modeled was the projection of how the number of affected birds would arrive at a facility during an acute (rapid onset with a short, but often times severe, course) versus a chronic (lasts for a long period of time, or marked by frequent recurrence) spill. Within this model, the total rehabilitation operation is based on a 28 day timeline, an estimator supported by most major spill events in California.

Within the model, animal-related variables that can be changed include: total number of live oiled birds transported to the facility; the percent of viable intake birds; the percent daily survival of oiled birds; the percent daily survival of washed birds; percent of birds that are stable for wash on a given day; the number of birds washed per day; and the percent of clean birds that live to be released. For the purposes of this project, the following variables were held constant based on the OWCN's best professional judgment as to what would be seen in a stereotypical acute spill affecting 1 kg birds in the Pacific Northwest, assuming space, utilities and personnel were not limiting factors in the response (i.e. enough water, electricity, and intake stations would be available to provide animal care):

1. *90 percent viable birds at intake*
2. *90 percent daily survivability of oiled birds*
3. *97 percent daily survivability of washed birds*
4. *75 percent of assessed birds are stable for wash on each wash day*
5. *60 percent of assessed clean birds released.*

Table 1 illustrates the animal and facility model results for oil spills affecting 6,000, 1,000, or 100 birds.

Table 1: Results of OWCN Planning Model based on assumptions from WDFW, (60 intakes/station/day, 20 oiled birds/pen, 16 washed/station/day, 12 clean birds/pen, 15 birds/pool).

Total Live Intakes	Days to Set Up Wash	Days to End of Spill	Release	Intake Stations Needed	Oiled Bird Pens Needed	Wash/ Rinse Stations Needed	Drying Pens Needed	Pools Needed	Max. Water Use (gal)	Max. Indoor Space (sq. ft.)	Max. Outdoor Space (sq. ft.)
6000	2	41	3337 (55.6%)	38	131	78	104	199	3,215,055	30,102	39,991
1000	2	32	556 (55.7%)	7	22	13	18	34	545,874	6,222	6,833
100	2	23	55 (55.2%)	1	3	2	2	4	76,202	2,434	804

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Appendix A: Graphs of Oiled Bird Intake during an Oil Spill Response